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Lawrence et al.

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(54) **TWO-SPEED CLUTCH AND KIT**

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(51) **Int. Cl.**

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F16D 13/58	(2006.01)
F16D 27/00	(2006.01)
F16D 27/01	(2006.01)
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(52) **U.S. Cl.**

CPC ***F16D 13/58*** (2013.01); ***F16D 27/004*** (2013.01); ***F16D 27/01*** (2013.01); ***F16D 27/14*** (2013.01); *Y10T 29/49105* (2015.01); *Y10T 29/49716* (2015.01)

(58) **Field of Classification Search**

CPC H01K 49/043; H01K 49/04; F16D 27/01; F16D 29/00

USPC 310/156.13

See application file for complete search history.

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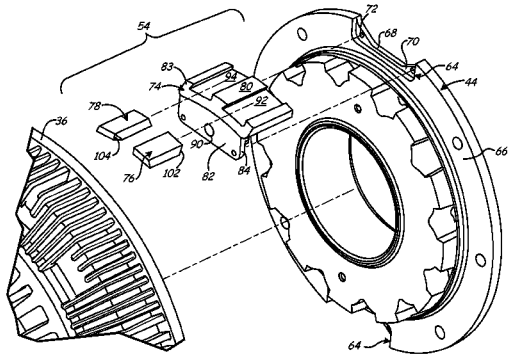
(57) **ABSTRACT**

A magnet holder assembly suitable for use as an eddy current drive of a clutch includes magnet holder means for securing one or more magnets to a rotatable component of the clutch, a first permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet has a beveled edge configured to mate with the magnet holder means, and a second permanent magnet radially retained by the magnet holder means. The first permanent magnet and the second permanent magnet have magnetic orientations arranged substantially opposite one another.

19 Claims, 6 Drawing Sheets



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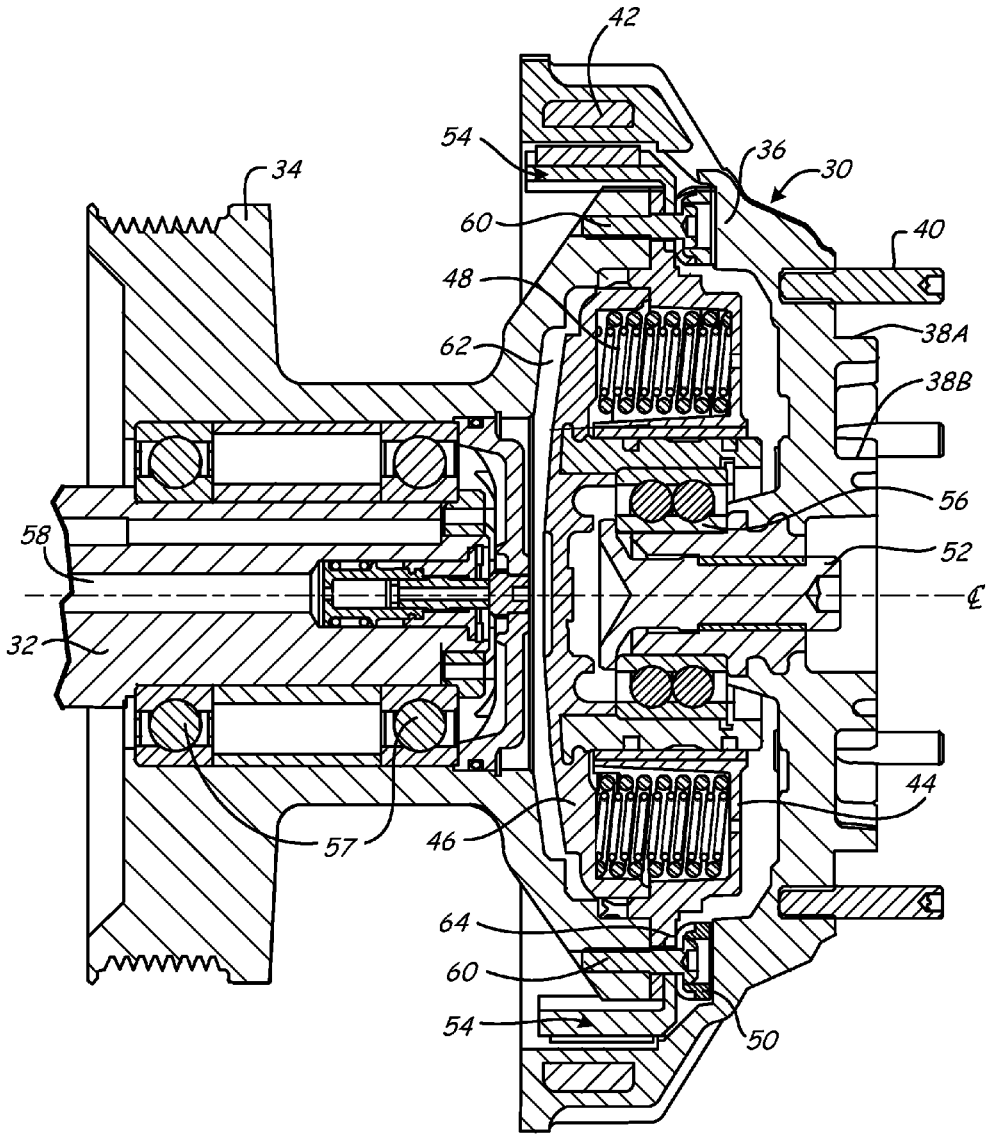

Fig. 1

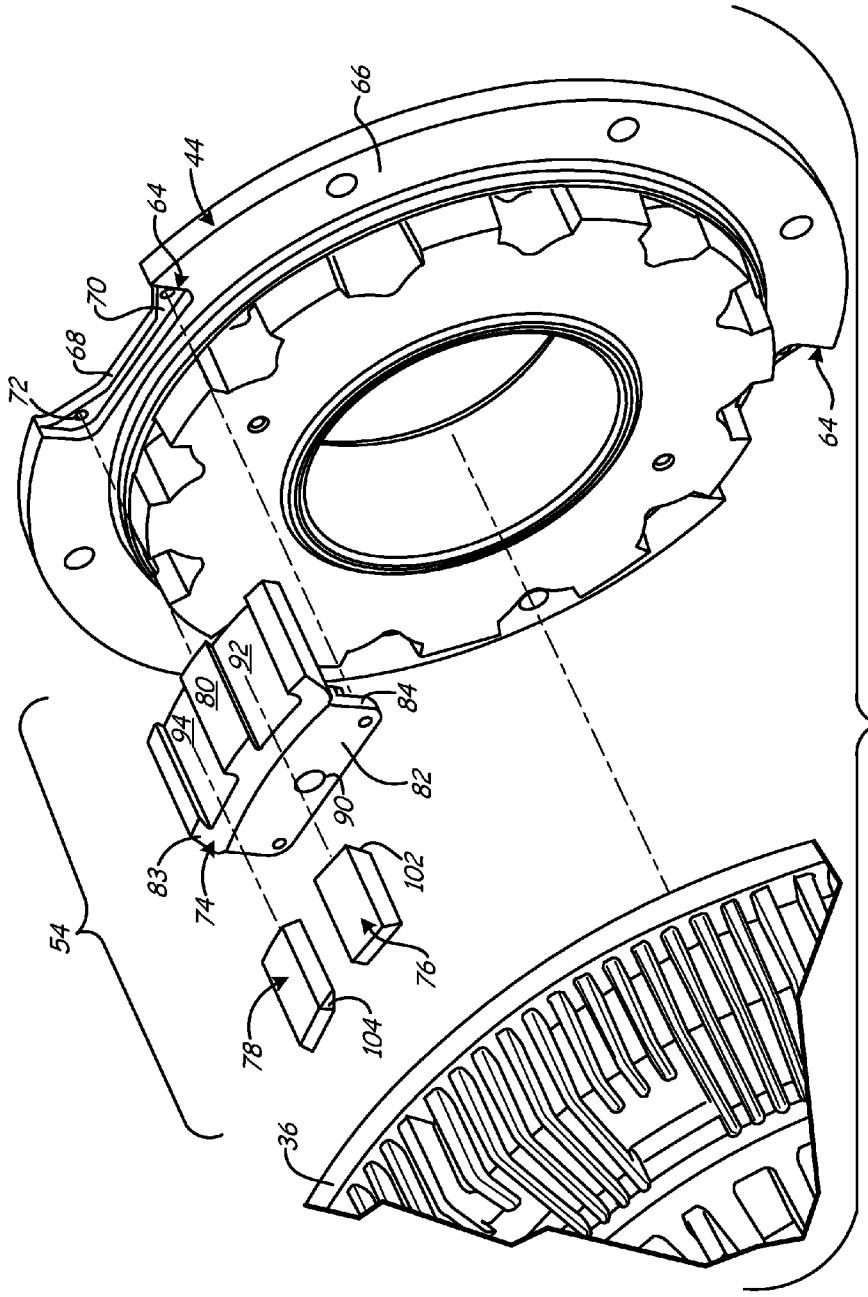

Fig. 2

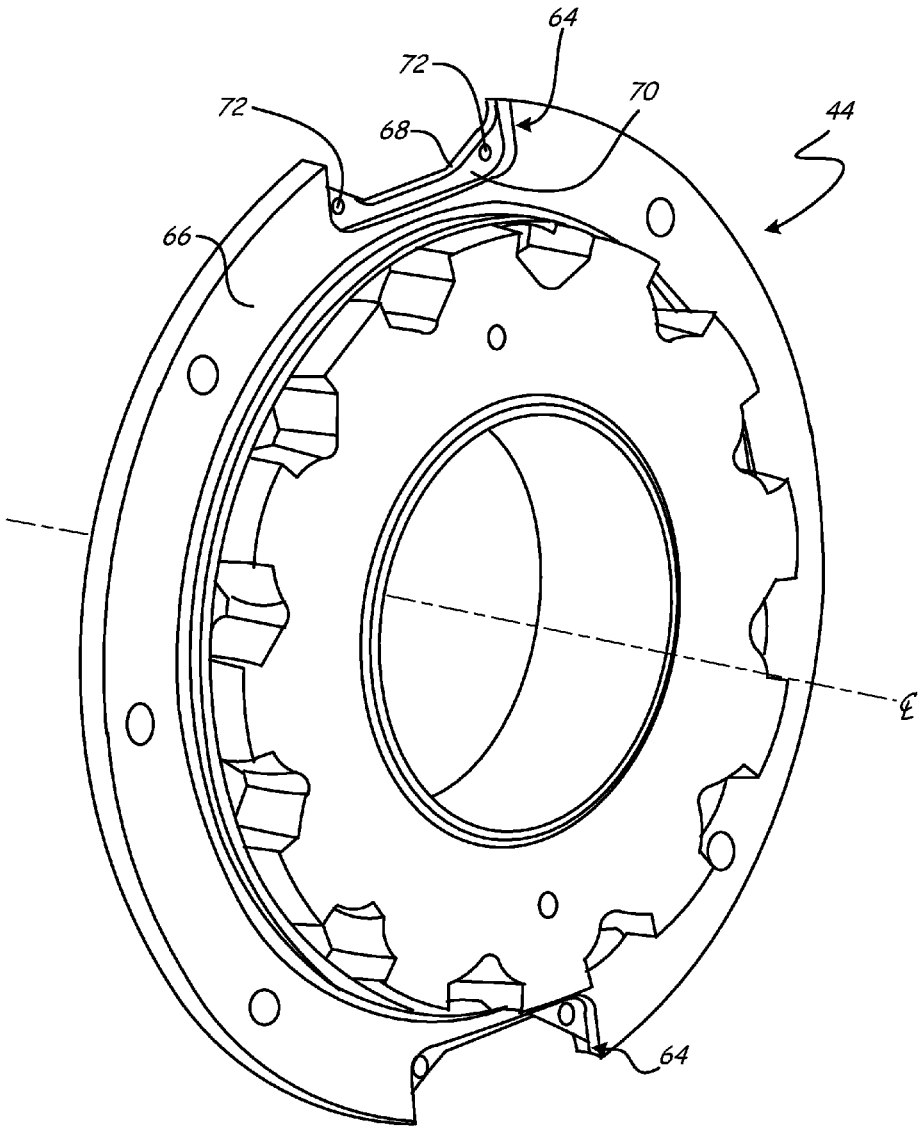

Fig. 3

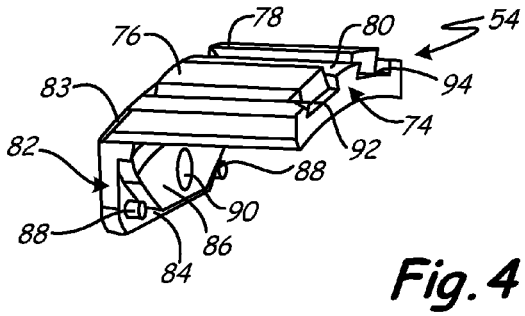

Fig. 4

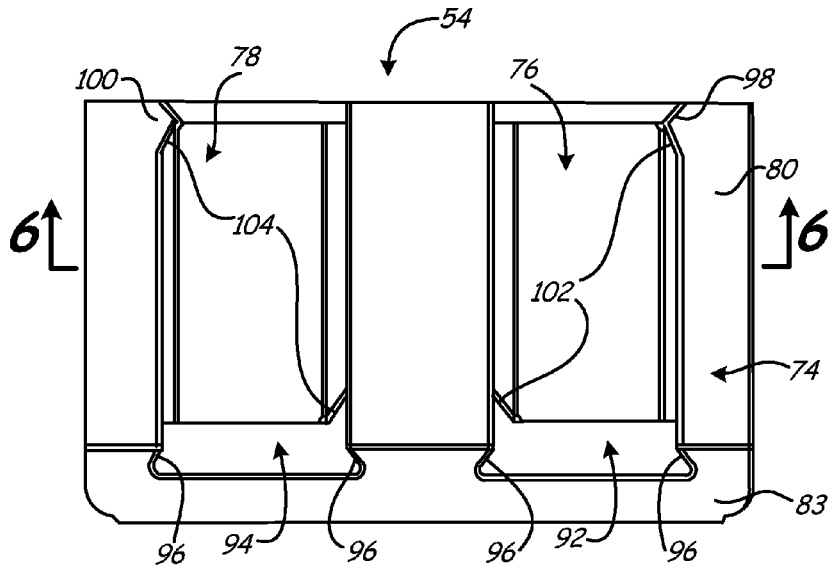

Fig. 5

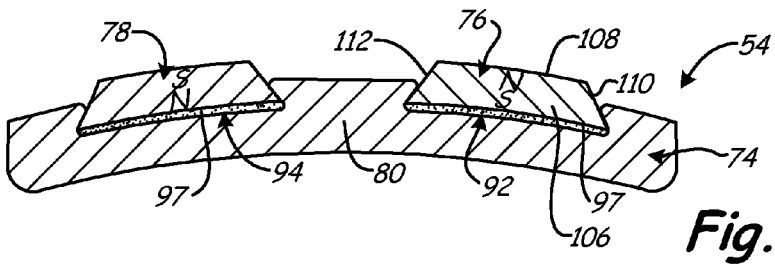

Fig. 6

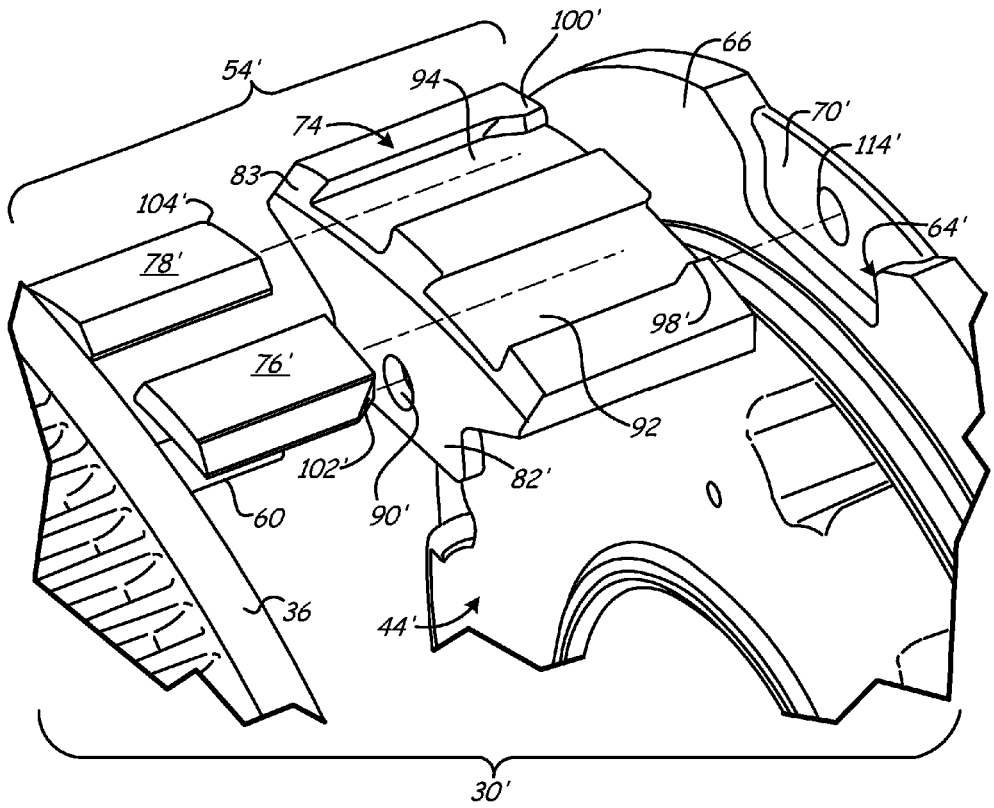

Fig. 7

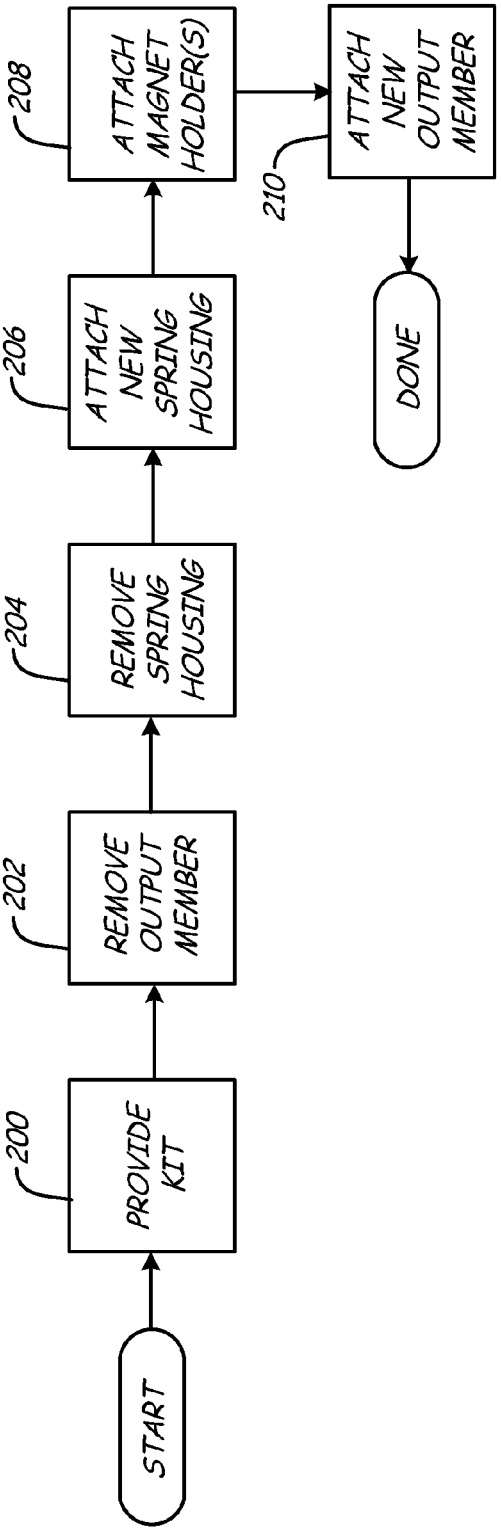
START
200
PROVIDE KIT
202
REMOVE OUTPUT MEMBER
204
REMOVE SPRING HOUSING
206
ATTACH NEW SPRING HOUSING
208
ATTACH MAGNET HOLDER(S)
210
ATTACH NEW OUTPUT MEMBER
DONE

Fig. 8

TWO-SPEED CLUTCH AND KIT

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application is a continuation of U.S. patent application Ser. No. 13/124,760, entitled "Two-Speed Clutch and Retro-Fit Kit," filed Apr. 18, 2011, which is a §371 national-phase application of PCT Application PCT/US2009/064168, filed Nov. 12, 2009, which claims priority to U.S. Provisional Patent Application No. 61/198,965, entitled "Two-Speed Clutch and Retro-Fit Kit" filed Nov. 12, 2008, and U.S. Provisional Patent Application No. 61/210,394, entitled "Two-Speed Clutch and Retro-Fit Kit" filed Mar. 18, 2009, all of which are hereby incorporated by reference in their entireties.

BACKGROUND

The present invention relates generally to clutches, and more generally to two-speed clutches suitable for automotive applications.

On/off friction clutches that provide only a single engagement speed are known, such as the DriveMaster® spring-engaged fan drive available from Horton, Inc., Roseville, Minn. Many vehicles have had such on/off friction clutches installed. Two speed clutches are also known, such as the DriveMaster® two-speed fan drive available from Horton, Inc., which utilize a spring-engaged friction clutch in conjunction with an eddy current drive that engages the drive when the spring-engaged friction clutch is disengaged to provide a second, slower engagement speed. A clutch retro-fit kit is known from U.S. Patent Application Publication No. 2009/0183963.

The present invention provides an alternative two-speed clutch, as well as a kit that allows a retrofit or conversion of an on/off clutch to a two-speed clutch.

SUMMARY

A magnet holder assembly suitable for use as an eddy current drive of a clutch includes magnet holder means for securing one or more magnets to a rotatable component of the clutch, a first permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet has a beveled edge configured to mate with the magnet holder means, and a second permanent magnet radially retained by the magnet holder means. The first permanent magnet and the second permanent magnet have magnetic orientations arranged substantially opposite one another.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a clutch according to the present invention.

FIG. **2** is an exploded perspective view of a portion of the clutch of FIG. **1**.

FIG. **3** is a perspective view of a spring housing of the clutch.

FIG. **4** is a perspective view of one embodiment of a magnet holder assembly of the clutch.

FIG. **5** is a plan view of the magnet holder assembly of FIG. **4**.

FIG. **6** is a cross-sectional view of the magnet holder assembly, taken along line **6-6** of FIG. **5**.

FIG. **7** is an exploded perspective view of a portion of another embodiment of a clutch according to the present invention.

FIG. **8** is a flow chart illustrating a method of retro-fitting a clutch according to the present invention.

While the above-identified drawing figures set forth several embodiments of the invention, other embodiments are also contemplated, as noted in the discussion. In all cases, this disclosure presents the invention by way of representation and not limitation. It should be understood that numerous other modifications and embodiments can be devised by those skilled in the art, which fall within the scope and spirit of the principles of the invention. The figures may not be drawn to scale. Like reference numbers have been used throughout the figures to denote like parts.

DETAILED DESCRIPTION

FIG. **1** is a cross-sectional view of an embodiment of a clutch **30** secured to a mounting bracket **32**. FIG. **2** is an exploded perspective view of a portion of the clutch **30**. The clutch **30** includes an input member **34** (e.g., a sheave or pulley member) and a cover **36** (also called a fan-mounted friction disk) configured relative to a centerline axis C_L. A belt or other structure (not shown) can be operatively engaged with the input member **34** to provide a rotational input force to rotate the input member **34**. The cover **36** has pilots **38**A and **38**B, threaded fasteners **40**, and an eddy-current conducting ring **42**. The clutch **30** further includes a spring housing **44**, a piston plate **46**, one or more springs **48**, friction material **50**, a locking member **52**, one or more magnet holder assemblies **54**, and bearing sets **56** and **57**. The mounting bracket **32** has an internal passageway **58** for supplying a pressurized fluid from a source (not shown) to the clutch **30**. The clutch **30** permits the cover **36** to be selectively rotated in response to rotational input, such that during operation the cover **36** can rotate with the input member **34** at a selected speed.

A fan (not shown), or other component, can be mounted to the cover **36**. The fan pilots **38**A and **38**B are arranged concentrically about the centerline axis C_L. The fan can be mounted to either fan pilot **38**A or **38**B, such as with a press-in fastener for the fan pilot **38**B or threaded fasteners **40** for the fan pilot **38**A. Other types of fasteners and fastener arrangements are possible in further embodiments. A fan spacer (not shown) can optionally be used when mounting the fan to the cover **36**. The cover **36** is thus suitable to fit most common fan offsets, and can provide a neutral placement of the fan relative to surrounding cooling system components.

The input member **34** is rotatably mounted to the mounting bracket **32** by the bearing sets **37**. The spring housing **44** and the friction material **50** are fixedly mounted to the input member **34** by fasteners **60**, and are configured to rotate therewith. The piston plate **46** is slidably mounted and rotationally fixed relative to the spring housing **44**, and is configured to rotate therewith. A fluid chamber **62** is defined at least partially between the input member **34** and the piston plate **36**, and is in fluid communication with the passageway **58** through the mounting bracket **32**. The springs **48** are engaged between the spring housing **44** and the piston plate **46**. The cover **36** is rotatably mounted relative to the piston plate **46** by the bearing set **56**. The locking member **52** releasably secures the cover **36** and the bearing set **56** to each other.

The clutch **30** in the illustrated embodiment has a two-speed configuration, with both a friction drive and an eddy current drive (also known as a hysteresis drive). When the friction drive is disengaged, the eddy current drive transmits torque to provide a rotational output at a first rotational speed,

which generally is less than a rotational input speed associated with the rotational input force. When the friction drive is engaged, the frictional engagement transmits torque to provide a rotational output at a second rotational speed. Typically the second rotational speed is greater than the first rotational speed, with the second rotational speed being essentially equal to the rotational input speed. The general operation of a two-speed clutch is described in U.S. Pat. Nos. 5,613,586 and 6,838,796.

In the illustrated embodiment, the piston plate **46** is axially moveable to provide the on/off friction drive. By default, the one or more springs **44** bias the piston plate **46** away from the spring housing **44**, which in turn pulls the cover **36** toward the friction material **50** such that frictional engagement between the friction material **50** and the cover **36** occurs. Frictional engagement permits torque transmission between the input member **32** and the cover **36** with the input and output speeds being approximately equal. Pressurized fluid can be selectively delivered to the fluid chamber **62** through the passageway **58** to disengage the on/off friction drive. The pressurized fluid introduced to the fluid chamber **62** can axially displace the piston plate **46**, compressing the springs **48**. Fluidically-induced axial displacement of the piston plate **46** against the force of the springs **48**, producing a corresponding axial displacement of the cover **36**, which is moved away from the friction material **50**.

The eddy current drive can allow a relatively low-speed rotational engagement between the input member **54** and the cover **56** when the friction drive is disengaged. Torque transmission through eddy current engagement is facilitated by way of the ring **42** and the one or more magnet holder assemblies **54**, which are described further below. In the illustrated embodiment, two substantially equally angularly spaced magnet holder assemblies **54** are provided. However, in further embodiments any number of magnet holder assemblies **54** can be utilized. The magnet holder assemblies in the illustrated embodiment are radially opposed from the ring **42**, and are separated from the ring **42** of the cover **36** by a generally radial air gap, though other configurations are possible in alternative embodiments.

In the illustrated embodiment, the ring **42** is a steel insert cast into aluminum material of the cover **36**, such as in the manner disclosed in U.S. Pat. No. 5,994,810. In alternative embodiments, the ring **42** can be secured to or formed as part of the cover **36** in any suitable manner, such as being mechanically attached to the cover **36** with suitable fasteners. The ring **42** forms part of the eddy current drive to complete a magnetic flux circuit during operation. It should be noted that in alternative embodiments, the ring **42** can have different orientations and be made of any material capable of conducting eddy currents. Indeed, in some alternative embodiments the ring **42** can be omitted and the eddy current drive engaged merely by at least a portion of the material (e.g., aluminum) of the cover **36**.

Those of ordinary skill in the art will recognize that the clutch **30** can include additional components not specifically mentioned herein. Moreover, those of ordinary skill in the art will recognize that in alternative embodiments the on/off friction drive of the clutch **30** can be of any conventional configuration. For example, in one embodiment the on/off friction drive of the clutch **30** can be similar to that of a DriveMaster® spring-engaged, pneumatically-actuated fan drive commercially available from Horton, Inc., Roseville, Minn. In another embodiment the on/off friction drive of the clutch **30** can be similar to that described in U.S. Pat. No. 6,092,638. In various embodiments, the actuation means for the on/off friction drive can be pneumatic, hydraulic, electromagnetic, or utilize any other suitable actuation means.

FIG. **3** is a perspective view of the spring housing **44**. In the illustrated embodiment, the spring housing **44** includes a plurality of insets **64** to accommodate a corresponding number of the magnet holder assemblies **54**. Each inset **64** is defined in an outer diameter (OD) portion **66** of the spring housing **44**. The plurality of insets **64** can be angularly spaced from one another about the centerline axis C_L. In the illustrated embodiment two insets **64** are provided in a diametrically opposed relationship. All of the insets **64** can have the same shape, and can each include an opening **68** that extends through an entire thickness of the OD portion **66** of the spring housing **44** and an abutment portion **70** that extends only partially through part of the thickness of the OD portion **66**. The opening **68** can extend to a circumferential edge of the spring housing **44**. One or more retention holes **72** can be provided in the abutment portion **70**. In alternative embodiments, the spring housing **44** can have the entire inset extend through the thickness of the OD portion **66** (i.e., the abutment portion **70** is omitted). In further alternative embodiments, the spring housing **44** can have insets that do not extend through the entire thickness of OD portion **66** (i.e., the openings **68** are omitted).

FIG. **4** is a perspective view of one embodiment of a magnet holder assembly **54**, FIG. **5** is a plan view of the magnet holder assembly **54**, and FIG. **6** is a cross-sectional view of the magnet holder assembly **54**, taken along line **6-6** of FIG. **5**. As shown in FIGS. **4-6**, the magnet holder assembly **54** includes a magnet holder **74** and first and second magnets **76** and **78**, respectively. The magnet holder **74** includes a body portion **80** and a flange **82**. The body portion **80** can extend in a generally axial direction, and can have an arcuate shape that follows the curvature of the OD portion **66** of the spring housing **44**. In the illustrated embodiment the body portion **80** is relatively compact in size, and, for instance, is not an annular ring that circumscribes the centerline axis C_L, which helps to reduce weight of the clutch **30** and reduce the amount of material required to make the magnet holder **74**. The flange **82** can extend from a front region of the body portion **80** in a generally radial direction. A front edge **83** of the magnet holder **74** can be beveled to allow close spacing of the cover **36**.

In the illustrated embodiment, the flange **82** includes a first portion **84** and a second portion **86**. The first portion **84** is generally rectangular in shape and the second portion **86** is generally trapezoidal in shape and arranged substantially parallel to the first portion **84**. The insets **64** in the spring housing **44** can have a shape that generally corresponds to that of the flange **82** of the magnet holder **74**, with the shape of the abutment portion **70** corresponding to that of the first portion **84** and the shape of the opening **68** corresponding to that of the second portion **86**. A pair of retention features **88** extend from the first portion **84** of the flange **80** and are configured to engage the retention holes **72** in the spring housing **44**, which can help secure the magnet holder **74** to the spring housing **44** in conjunction with the fastener **60** positioned through an opening **90** in the flange **82** (see FIG. **1**). In the illustrated embodiment, the retention features **88** are each substantially cylindrical pin-like members that extend rearward from the first portion **84** of the flange **82** of the magnet holder **74** at opposite sides of the second portion **86**. When the magnet holder assembly **54** is secured to the spring housing **44**, the retention features **88** each extend at least partially into the corresponding retention holes **72** to interlock those components and provide radial retention. The retention features **88** and retention holes **72** provide redundant radial retention of

the magnet holder **74** relative to the spring housing **44** as a fail-safe mechanism in the event of a failure of the fastener **60**. The inset **64** of the spring housing **44** can also provide angular and radial locating features for installation of the magnet holder assemblies **54**, which can facilitate assembly of the clutch **30**, or likewise facilitate retro-fit installation of a two speed kit to the clutch **30**.

As shown in FIGS. **4-6**, the body portion **80** of the magnet holder **74** defines first and second retention grooves **92** and **94**, respectively, that allow first and second magnets **76** and **78** (or any other mating components) to be engaged and radially restrained therein when subject to a centrifugal force. The grooves **92** and **94** can each have a generally dovetailed or beveled shape that mechanically obstructs radial movement of the magnets **76** and **78** while still leaving radially outward portions of the magnets **76** and **78** exposed. Sidewalls **96** of the grooves **92** and **94** can be arranged at about 30° angles with respect to radii projected from the centerline axis C_L, or at other angles as desired. The grooves **92** and **94** can extend between front and rear sides of the body portion **80** of the magnet holder **74** in a generally axial direction. As illustrated, the grooves **92** and **94** are substantially open at both ends, but in alternative embodiments one or both of the grooves **92** and **94** could have one end closed by material of the body portion **80**.

An adhesive **97** can be used to secure each of the magnets **76** and **78** to the body portion **80** of the magnet holder **74**, which can help limit movement of the magnets **76** and **78** within the grooves **92** and **94**, respectively. The adhesive **97** can be Loctite® 331™ structural adhesive (available from the Henkel Corporation). Stops **98** and **100** can be provided that extend into the first and second grooves **92** and **94**, respectively. In the illustrated embodiment, both stops **98** and **100** are positioned at or near a rear side of the magnet holder **74**, and acts to limit axial movement of the first and second magnets **76** and **78** within the respective first and second grooves **92** and **94**. Furthermore, the stop **98** is located at an outer sidewall **96** of the first groove **92** (i.e., a right hand sidewall **96** of the first groove **92** in FIG. **5**), and the stop **100** is located at an opposite outer sidewall **96** of the second groove **94** (i.e., a left hand sidewall **96** of the second groove **94** in FIG. **5**). The stops **98** and **100** can facilitate assembly, by simplifying alignment of the magnets **76** and **78** relative to the magnet holder **74**. The stops **98** and **100** can be formed, for instance, by mechanically deflecting corners of the sidewalls **96** of the grooves **93** and **94**, or by any other suitable manner.

The magnets **76** and **78** can each be made of a rare earth permanent magnet material, such as a magnetized neodymium-iron-boron material. Furthermore, the first and second magnets **76** and **78** can each optionally have a locating feature **102** and **104**, respectively, configured to cooperate with the stops **98** and **100** to help ensure desired magnetic orientation (i.e., North/South pole orientation) of the magnets **76** and **78**. In the illustrated embodiment, the locating features **102** and **104** are pairs of notches located at diagonally opposed corners of each of the magnets **76** and **78**, respectively, and have shapes that correspond to that of the stops **98** and **100**, respectively. In alternative embodiments, each of the magnets **76** and **78** can include only a single locating feature **102** and **104**. The locating features **102** and **104** can be positioned at opposite sides of the magnets **76** and **78**, for example, the locating features **102** are positioned at right-rear and left-forward corners of the magnet **76** and the locating features **124** are positioned at left-rear and right-forward corners of the magnet **78**, as shown in FIG. **5**. In this way, the locating features **102** and **104** can be associated with each of the magnets **76** and **78** to provide a physical and visual identifier of the polarity of the magnets **76** and **78**, and to help ensure that the magnets **76** and **78** are installed in the respective grooves **92** and **94** with desired magnetic orientations. In the illustrated embodiment, as shown in FIG. **6**, the first magnet **76** has a North pole facing radially outward and the second magnet **78** has a South pole facing radially outward, such that the magnetic orientations (i.e., polarities) of the first and second magnets **76** and **78** are substantially opposite one another, which facilitates eddy current generation between the magnet holder assembly **54** and the ring **42** during operation of the eddy current drive of the clutch **30**.

The first and second magnets **76** and **78** can each be configured to have a cross-sectional profile that generally corresponds to the shape of the first and second grooves **92** and **94**, respectively. In the illustrated embodiment, the first and second magnets **76** and **78** each have generally curved, trapezoidal cross-sectional profiles. More specifically, the magnets **76** and **78** can each have arcuate radially inner and radially outer surfaces **106** and **108**, respectively, and beveled side surfaces **110** and **112**, which can define an included angle of about 60° in one embodiment (i.e., each side surface **110** and **112** is arranged at about 30° with respect to radii projected from the centerline axis C_L). It should be noted that the particular configuration of the magnets **76** and **78** can vary as desired in further embodiments. The side surfaces **110** and **112** of the magnets **76** and **78** are configured to cooperatively engage and physically contact the sidewalls **96** of the grooves.

Magnets used with eddy current drives are frequently made of relatively brittle materials, which may be prone to undesirable fracturing or other damage during assembly and use. Mechanical fasteners (e.g., screws, bolts) that exert clamp-like forces on magnets may undesirably cause damage to such magnets. In the illustrated embodiment, neither the grooves **92** and **94** nor the adhesive **97** exerts a positive clamping force on the magnets **76** and **78**, but the assemblies **54** reduce or eliminate the need for a mechanical fastener for retention of the magnets **76** and **78**. In this way the magnet holder assemblies **54** can help to reduce or eliminate stress concentrations that would otherwise occur due to a clamp-like load exerted on the magnets **76** and **78** by fasteners. Moreover, the grooves **92** and **94** help reduce a risk of the magnets **76** and **78** dislodging due to failure of the adhesive **97** during operation. Dislodged magnets can impact other clutch components or become wedges between rotating parts, presenting an elevated risk of damage to the rest of the clutch. Moreover, loss of a magnet decreases eddy current drive operation. Redundant retention mechanisms according to the present invention help reduce such risks.

The magnet holder assemblies **54** can each be installed axially with respect to the centerline axis C_L of the clutch **30**. In preferred embodiments, the magnet holder assemblies **54** can each be installed from a front area of the clutch **30**, allowing installation of the magnet holder assemblies **54** upon removal of, or prior to installation of, the cover **36**, but without requiring that other components of the clutch **30**, such as the piston plate **46**, be removed or uninstalled.

FIG. **7** is an exploded perspective view of a portion of another embodiment of a clutch **30'**. The clutch **30'** is generally similar to the clutch **30** described above, but magnet holder assemblies **54'** and a spring housing **44'** have alternative configurations. In the embodiment illustrated in FIG. **7**, a flange **82'** of a magnet holder **74'** and an inset **64'** in the OD portion **66** of the spring housing **44'** have corresponding dovetail shapes, which help to radially secure the magnet holder **74'** to the spring housing **44'** even in the event the fastener **60** engaged through the openings **90'** in the flange **82** and an opening **114'** in an abutment portion **70'** of the inset **64'** fails.

In that way, the fastener **60** and the corresponding shapes of the flange **82'** and the inset **64'** provide redundant engagement mechanisms as a fail-safe measure. In alternative embodiments, the flange **82'** and inset **64'** can have other, non-dovetail configurations. The inset **64'** of the spring housing **44'** can also provide angular and radial locating features for installation of the magnet holder assemblies **74'**, which can facilitate assembly of the clutch **30'**, or likewise facilitate retro-fit installation of a two speed kit to the clutch **30'**.

It will be recognized that the clutch **30** or **30'** can be provided as described herein as a new clutch, fully assembled and ready for installation in a desired location, such as in a vehicle. Alternatively, a two-speed kit can be provided to upgrade or retro-fit an existing single-speed on/off friction clutch to the two-speed clutch **30** or **30'**. For example, an existing DriveMaster® spring-engaged fan drive providing only on/off frictional engagement can be upgraded with a two-speed kit that adds an eddy current drive. Such a kit can include the cover **36**, the spring housing **44** or **44'**, and the magnet holder assemblies **54** or **54'** described above, as well as additional components as desired. In general, installation of the two-speed kit can involve replacement of an existing cover with the cover **36**, though it may be possible in some embodiments to continue use of an existing cover or use a new cover without the ring **42** as described above. Additionally, an existing spring housing can be replaced with the spring housing **44** or **44'** described above, with the one or more magnet holder assemblies **54** or **54'** installed on the spring housing **44** or **44'**. Such a two-speed kit allows a single-speed on/off clutch to be converted to a two-speed configuration without incurring any additional length penalty, allowing the clutch **50** to acquire an additional engagement speed while remaining relatively compact. Compact clutch sizes can be important given space constraints of many applications, such as installation within a vehicle engine compartment.

FIG. **8** is a flow chart illustrating a method of retro-fitting an existing single-speed on/off clutch with an eddy current drive add-on kit to produce a two-speed clutch. A kit is provided for use with an existing clutch (step **200**). An existing output member (e.g., a fan mounted friction disk) of the clutch is removed (step **202**), which can include releasing a locking member. An existing spring housing is also removed from the clutch (step **204**), which can include removing fasteners. A piston member and other components of the clutch can generally remain in place as the output member and the spring housing are removed, as desired. Next, a new spring housing having inset features is attached to the clutch (step **206**) and all magnet holder assemblies are attached to the new spring housing at the corresponding insets (step **208**). Steps **206** and **208** can be performed in any order, as desired. Finally, a new output member is attached to the clutch (step **210**). As noted above, in alternative embodiments the existing output member can be re-attached to the clutch. It should also be noted that components referred to herein as "new" can include previously unused, refurbished or salvaged parts.

It will be recognized that the present invention provided numerous advantages and benefits. For example, the addition of a two-speed kit to an existing single-speed on/off friction clutch according to the present invention can produce a zero overall length penalty, that is, the overall axial dimension of the clutch can remain essentially constant upon the installation of the two-speed kit. The two-speed kit thereby provides convenient means of utilizing existing on/off friction clutch designs with added versatility of the two-speed kit design improvements. This also allows users to upgrade existing clutches at relatively low costs, because existing on/off friction clutch components and an existing fan can be re-used. Moreover, the magnet holders of the present invention utilize adhesive and special part geometries to help radially retain the permanent magnets without undesirable clamp loads, and attachments of various components are made with redundant retention mechanisms to help provide fail-safe operation. In addition, the present invention provides for relatively easy assembly or relatively easy retro-fitting of an existing clutch.

While the invention has been described with reference to an exemplary embodiment(s), it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment(s) disclosed, but that the invention will include all embodiments falling within the scope of the appended claims. For example, additional clutch drives can be included for providing more than two engagement speeds. Moreover, magnet holder assemblies of the present invention can include more or less than two magnets, and any number of magnet holder assemblies can be provided.

The invention claimed is:

1. A magnet holder assembly suitable for use as an eddy current drive of a clutch, the assembly comprising:
- magnet holder means for securing one or more magnets to a rotatable component of the clutch;
- retention means for radially retaining the magnet holder assembly relative to the clutch, wherein the retention means comprises a dovetailed flange;
- a first permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet has a beveled edge configured to mate with the magnet holder means; and
- a second permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet and the second permanent magnet have magnetic orientations arranged substantially opposite one another.

2. The assembly of claim **1**, wherein magnet holder means comprises a body having a first groove, and wherein the first groove has an angled sidewall configured to help retain the first permanent magnet along the beveled edge.

3. The assembly of claim **1** and further comprising:
- second retention means for radially retaining the magnet holder assembly relative to the clutch, wherein the second retention means are spaced from the first retention means.

4. The assembly of claim **1** and further comprising:
- a first angled stops located along a first groove in the magnet holder means;
- a second angled stop located along a second groove in the magnet holder means;
- a first corner notch on the first permanent magnet; and
- a second corner notch on the second permanent magnet, wherein the first and second corner notches are arranged at different corners of the first and second magnets such that the first corner notch can engage the first angled stop but not the second angled stop and such that the second corner notch can engage the second angled stop but not the first angled stop.

5. A magnet holder assembly suitable for use as an eddy current drive of a clutch, the assembly comprising:
- magnet holder means for securing one or more magnets to a rotatable component of the clutch;

retention means for radially retaining the magnet holder assembly relative to the clutch, wherein the retention means comprises a pin-like member extending substantially axially from a flange;

a first permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet has a beveled edge configured to mate with the magnet holder means; and

a second permanent magnet radially retained by the magnet holder means, wherein the first permanent magnet and the second permanent magnet have magnetic orientations arranged substantially opposite one another.

6. The assembly of claim **5** and further comprising:

a fastener opening in the flange.

7. A clutch apparatus comprising:

a housing rotatably fixed relative to an input member;

a cover rotatably mounted relative to the input and axially moveable relative to the input, wherein at least a portion of the cover comprises a material capable of conducting eddy currents;

a first magnet holder removably attached to the housing and rotatably fixed relative to the housing, the first magnet holder comprising:

a body portion, wherein a first retention groove is defined in the body portion, and wherein the body portion of the first magnet holder has a curved configuration; and

a flange extending from the body portion opposite the first retention groove, wherein the flange has a connection feature for securing the first magnet holder to the housing; and

a first permanent magnet carried by the first retention groove in the first magnet holder, wherein the first retention groove restricts movement of the first permanent magnet in a radial direction while providing a magnet access passage in another direction through which the first permanent magnet can pass, and wherein the first permanent magnet is positioned in an opposing relationship relative to the material of the cover capable of conducting eddy currents,

wherein axial movement of the cover selectively engages and disengages a frictional torque coupling between cover and the input member, and

wherein in a frictionally disengaged axial position the cover is configured to rotate with the input by way of an eddy current coupling at a speed different from that provided by the frictional torque coupling.

8. The clutch apparatus of claim **7**, the housing further comprising:

a first inset, wherein the flange of the first magnet holder engages the first inset to attach the first magnet holder to the housing.

9. The clutch apparatus of claim **8**, wherein the first inset is located at an outer diameter portion of the housing and has a first portion and a second portion, wherein the second portion of the inset extends between opposite faces of the housing, the second portion of the inset having a shape corresponding to that of the second portion of the flange of the first magnet holder, and wherein the first portion of the inset is located adjacent to the second portion of the inset and is configured as a recess at one face of the housing, the first portion of the inset having a shape corresponding to that of the first portion of the flange of the first magnet holder.

10. The clutch apparatus of claim **7**, wherein the first retention groove comprises a dovetail shaped groove in the body portion of the first magnet holder, and wherein the first permanent magnet has a shape that is complementary with that of the first retention groove.

11. The clutch apparatus of claim **7** and further comprising:

a first retention feature on one of the housing and the flange of the first magnet holder, wherein the first retention feature is a pin member extending from the flange; and

an opening on the other of the housing and the flange of the first magnet holder, wherein the first retention feature extends at least partially into the opening to help retain the first magnet holder assembly relative to the housing.

12. The clutch apparatus of claim **7** and further comprising:

a stop located on the body portion of the magnet holder at or adjacent to the first retention groove.

13. The clutch apparatus of claim **12** and further comprising:

a locating feature on the first permanent magnet configured for cooperative engagement with the stop when the first permanent magnet is engaged with the first groove only when the first permanent magnet is arranged with a first magnetic orientation.

14. The clutch apparatus of claim **7** and further comprising:

a second retention groove defined in the body portion of the first magnet holder adjacent to the first retention groove; and

a second permanent magnet engaged with the second retention groove, wherein the first permanent magnet and the second permanent magnet have magnetic orientations arranged substantially opposite one another.

15. The clutch apparatus of claim **7**, wherein the portion of the cover that comprises the material capable of conducting eddy currents comprises a conducting ring embedded in or secured to a body portion of the cover.

16. The clutch apparatus of claim **7**, wherein the cover comprises an aluminum material, and wherein portion of the cover that comprises the material capable of conducting eddy currents comprises a portion of the aluminum material.

17. The clutch apparatus of claim **7**, wherein the first retention groove of the first magnet holder extends in a generally axial direction.

18. The clutch apparatus of claim **7** and further comprising:

securing means for limiting permanent magnet movement through the magnet access passage.

19. A clutch apparatus comprising:

a housing rotatably fixed relative to an input member;

a cover rotatably mounted relative to the input and axially moveable relative to the input, wherein at least a portion of the cover comprises a material capable of conducting eddy currents;

a first magnet holder removably attached to the housing with a first fastener and rotatably fixed relative to the housing, the first magnet holder defining a first retention groove, wherein the first fastener further secures the housing to the input member;

a first permanent magnet carried by the first retention groove in the first magnet holder, wherein the first retention groove restricts movement of the first permanent magnet in a radial direction while providing a magnet access passage in another direction through which the first permanent magnet can pass, and wherein the first permanent magnet is positioned in an opposing relationship relative to the material of the cover capable of conducting eddy currents; and

a second magnet holder removably attached to the housing with a second fastener and rotatably fixed relative to the housing, wherein the second magnet holder is circumferentially spaced from the first magnet holder, and

wherein the second magnet holder carries one or more additional permanent magnets,

wherein axial movement of the cover selectively engages and disengages a frictional torque coupling between cover and the input member, and

wherein in a frictionally disengaged axial position the cover is configured to rotate with the input by way of an eddy current coupling at a speed different from that provided by the frictional torque coupling.

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